
PART O
CONCRETE, CONCRETE FORMS, SHORING, AND MASONRY CONSTRUCTION

WAC 296-155-675 Scope, application, and definitions applicable to this part.

- (1) Scope and application. This part sets forth requirements to protect all construction employees from the hazards associated with concrete and masonry construction operations performed in workplaces covered under chapter 296-155 WAC.
- (2) Definitions applicable to this part.
 - (a) **“Bull float”** means a tool used to spread out and smooth the concrete.
 - (b) **“Formwork”** means the total system of support for freshly placed or partially cured concrete, including the mold or sheeting (form) that is in contact with the concrete as well as all supporting members including shores, reshores, hardware, braces, and related hardware.
 - (c) **“Jacking operation”** means the task of lifting a slab (or group of slabs) vertically from one location to another (e.g., from the casting location to a temporary (parked) location, or from a temporary location to another temporary location, or to its final location in the structure), during the construction of a building/structure where the lift-slab process is being used.
 - (d) **“Lift slab”** means a method of concrete construction in which floor and roof slabs are cast on or at ground level and, using jacks, lifted into position.
 - (e) **“Limited access zone”** means an area alongside a masonry wall, which is under construction, and which is clearly demarcated to limit access by employees.
 - (f) **“Precast concrete”** means concrete members (such as walls, panels, slabs, columns, and beams) which have been formed, cast, and cured prior to final placement in a structure.
 - (g) **“Reshoring”** means the construction operation in which shoring equipment (also called reshores or reshoring equipment) is placed, as the original forms and shores are removed, in order to support partially cured concrete and construction loads.
 - (h) **“Shore”** means a supporting member that resists a compressive force imposed by a load.
 - (i) **“Vertical slip forms”** means forms which are jacked vertically during the placement of concrete.
 - (j) **“Guy”** means a line that steadies a high piece or structure by pulling against an off-center load.

[Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), § 296-155-675, filed 7/20/94, effective 9/20/94; 91-11-070 (Order 91-01), § 296-155-675, filed 5/20/91, effective 6/20/91; 90-03-029 (Order 89-20), § 296-155-675, filed 1/11/90, effective 2/26/90; 89-11-035 (Order 89-03), § 296-155-675, filed 5/15/89, effective 6/30/89; Order 74-26, § 296-155-675, filed 5/7/74, effective 6/6/74.]

WAC 296-155-680 General provisions.

- (1) General. All equipment, material and construction techniques used in concrete construction and masonry work shall meet the applicable requirements for design, construction, inspection, testing, maintenance and operations as prescribed in ANSI A10.9-1970, Safety Requirements for Concrete Construction and Masonry Work.

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- (2) Construction loads. No construction loads shall be placed on a concrete structure or portion of a concrete structure unless the employer determines, based on information received from a person who is qualified in structural design, that the structure or portion of the structure is capable of supporting the loads.
- (3) Vertical loads. Vertical loads consist of a dead load plus an allowance for live load. The weight of formwork together with the weight of freshly placed concrete is dead load. The live load consists of the weight of workers, equipment, runways and impact, and shall be computed in pounds per square foot (psf) of horizontal projection.
- (4) Lateral loads. Braces and shores shall be designed to resist all foreseeable lateral loads such as wind, cable tensions, inclined supports, impact of placement, and starting and stopping of equipment. The assumed value of load due to wind, impact of concrete, and equipment acting in any direction at each floor line shall not be less than one hundred pounds per lineal foot of floor edge or two percent of total dead load of the floor, whichever is greater. Wall forms shall be designed for a minimum wind load of ten psf, and bracing for wall forms should be designed for a lateral load of at least one hundred pounds per lineal foot of wall, applied at the top. Walls of unusual height require special consideration.
- (5) Special loads. Formwork shall be designed for all special conditions of construction likely to occur, such as unsymmetrical placement of concrete, impact of machine-delivered concrete, uplift, and concentrated loads.
- (6) Form supports and wedges shall be checked during concrete placement to prevent distortion or failure.
- (7) Reinforcing steel.
 - (a) All protruding reinforcing steel, onto and into which employees could fall, shall be guarded to eliminate the hazard of impalement.
 - (b) Wire mesh rolls: Wire mesh rolls shall be secured at each end to prevent dangerous recoiling action.
 - (c) Guying: Reinforcing steel for walls, piers, columns, and similar vertical structures shall be guyed and supported to prevent overturning and to prevent collapse.
- (8) Post-tensioning operations.
 - (a) No employee (except those essential to the post-tensioning operations) shall be permitted to be behind the jack during tensioning operations.
 - (b) Signs and barriers shall be erected to limit employee access to the post-tensioning area during tensioning operations.
- (9) Working under loads.
 - (a) No employee shall be permitted to work under concrete buckets while buckets are being elevated or lowered into position.
 - (b) To the extent practical, elevated concrete buckets shall be routed so that no employee, or the fewest number of employees, are exposed to the hazards associated with falling concrete buckets.

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- (10) Personal protective equipment.
- (a) No employee shall be permitted to apply a cement, sand, and water mixture through a pneumatic hose unless the employee is wearing protective head and face equipment.
 - (b) No employee shall be permitted to place or tie reinforcing steel more than six feet (1.8 m) above any adjacent working surface unless the employee is protected by personal fall arrest systems, safety net systems, or positioning device systems meeting the criteria of chapter 296-155 WAC, Part C-1.
 - (c) Each employee on the face of formwork or reinforcing steel shall be protected from falling 6 feet (1.8m) or more to lower levels by personal fall arrest systems, safety net systems, or positioning device systems meeting the criteria of chapter 296-155 WAC, Part C-1.

[Statutory Authority: RCW 49.17.010, .040, .050. 00-14-058 (Order 99-43), § 296-155-680, filed 07/03/2000, effective 10/01/2000. Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), § 296-155-680, filed 7/20/94, effective 9/20/94; 90-17-051 (Order 90-10), § 296-155-680, filed 8/13/90, effective 9/24/90; 90-03-029 (Order 89-20), § 296-155-680, filed 1/11/90, effective 2/26/90; 89-11-035 (Order 89-03), § 296-155-680, filed 5/15/89, effective 6/30/89. Statutory Authority: RCW 49.17.040 and 49.17.050. 86-03-074 (Order 86-14), § 296-155-680, filed 1/21/86; Order 74-26, § 296-155-680, filed 5/7/74, effective 6/6/74.]

WAC 296-155-681 Safe walking surfaces on concrete structural members. Structural members with studs, dowels, or shear connectors installed on the top side shall not be used as a walkway and/or means of access unless such studs, dowels, or shear connectors are covered with suitable material and in such a manner as to provide a walking surface at least as stable and free of hazards as the top surface of the member would provide without attachments installed.

Note: For the purpose of this section, “stud” means all protruding metal attachments to structural members.
[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-155-681, filed 5/15/89, effective 6/30/89.]

WAC 296-155-682 Requirements for equipment and tools.

- (1) Bulk cement storage. Bulk storage bins, containers, and silos shall be equipped with the following:
 - (a) Conical or tapered bottoms; and
 - (b) Mechanical or pneumatic means of starting the flow of material.
- (2) No employee shall be permitted to enter storage facilities unless the ejection system has been shut down and locked out in accordance with WAC 296-155-429.
- (3) Safety belts, harnesses, lanyards, lifelines or droplines, independently attached or attended, shall be used as prescribed in chapter 296-155 WAC, Part C-1.
- (4) Concrete mixers. Concrete mixers with one cubic yard (.8 m3) or larger loading skips shall be equipped with the following:
 - (a) A mechanical device to clear the skip of materials; and
 - (b) Guardrails installed on each side of the skip.
- (5) Power concrete trowels. Powered and rotating type concrete troweling machines that are manually guided shall be equipped with a control switch that will automatically shut off the power whenever the hands of the operator are removed from the equipment handles.
- (6) Concrete buggies. Concrete buggy handles shall not extend beyond the wheels on either side of the buggy.

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Note: Installation of knuckle guards on buggy handles is recommended.

(7) Runways.

- (a) Runways shall be constructed to carry the maximum contemplated load with a safety factor of four, have a smooth running surface, and be of sufficient width for two buggies to pass. Single runs to have a minimum width of forty-two inches with turnouts. Runways to have standard railings. Where motor driven concrete buggies are used, a minimum four-inches by four-inches wheel guard shall be securely fastened to outside edge of runways.
- (b) All concrete buggy runways which are 12 inches or more above a work surface or floor, or ramps with more than 4 percent incline shall be considered “elevated” runways.

Exception: Small jobs utilizing only one concrete buggy, or larger jobs utilizing a “one-way traffic pattern” may be exempt from the requirements for “turnouts” or for “sufficient width for two buggies to pass.”

Exemption: Runways less than 12 inches above the floor or ground which are utilized by hard-powered buggies only, may be exempt from the requirements for guardrails and wheelguards.

(8) Concrete pumps and placing booms.

(a) Definitions.

“Concrete delivery hose” means a flexible concrete delivery hose which has two end couplings.

“Concrete pump” means a construction machine that pumps concrete.

“Controls” means the devices used to operate a machine.

“Delivery systems” means the pipe, hoses and components, through which the concrete is pumped.

“Grooved end” means a pipe clamp pipe connection where a groove is machined or rolled directly into the outside of the pipe wall (for example: Victualic).

“Material pressure” means the pressure exerted on the concrete inside the delivery system.

“Placing boom and placing unit” means a manual or power driven, slewable working device which:

- Consists of one or more extendable or folding parts for supporting the concrete delivery system, and directs the discharge into the desired location; and
- May be mounted on trucks, trailers, or special vehicles.

“Qualified person” means someone who:

- Possesses a recognized degree or certificate of professional standing; or
- Has extensive knowledge, training, and experience; or
- Successfully demonstrated the ability to resolve problems relating to the work.

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“Restraining devices” means a sling, cable, or equivalent device used to minimize excess movement of a delivery system in case of separation.

“Whip hoses” means a suspended hose that has only one coupling and is used to direct the delivery of concrete.

(b) Equipment requirements.

(i) Equipment identification tag.

The employer must ensure the following identification is furnished if originally identified by the manufacturer and on all pumps manufactured after January 1, 1998:

- The manufacturer’s name;
- The year of manufacture;
- The model and serial number;
- The maximum material pressure;
- The maximum allowable pressure in the hydraulic system; and
- The maximum weight per foot of delivery system including concrete.

(ii) Manufacturer’s manual.

The employer must have the manufacturer’s operation/safety manual or equivalent available for each concrete pump or placing boom.

(iii) Unsafe condition of equipment.

If during an equipment inspection a condition is revealed that might endanger workers, the equipment must not be returned to service until the condition is corrected.

(iv) Controls.

Controls must have their function clearly marked.

(v) Hydraulic systems.

- (A) Concrete pumps and placing booms hydraulic systems must have pressure relief valves to prevent cylinder and boom damage.
- (B) Hydraulic systems must have hydraulic holding valves if hose or coupling failure could result in uncontrolled vertical movement

(iv) Certification.

In the event of failure of a structural member, overloading, or contact with energized electric power lines and before return to service, the equipment must be certified safe by:

- The manufacturer; or
- An agent of the manufacturer; or
- A professional engineer.

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- (vii) Marking weight. A permanent, legible notice stating the total weight of the unit must be marked on:
- Trailer or skid mounted concrete pumps;
 - Placing booms; and
 - All major detachable components over five hundred pounds.
- (viii) Lifting a pump.
- A concrete pump must be lifted using the lift points specified by the manufacturer or a professional engineer.
- (ix) Emergency shutoff.
- A concrete pump must have a clearly labeled emergency stop switch that stops the pumping action.
- (x) Inlet and outlet guarding.
- (A) The waterbox must have a fixed guard to prevent unintentional access to the moving parts.
- (B) The agitator must be guarded with a point of operation guard in accordance with chapter 296-806 WAC, Machine safety, and the guard must be:
- Hinged or bolted in place;
 - At least three inches distance from the agitator;
 - Be capable of supporting a load of two hundred fifty pounds.
- (C) A person must not stand on the guard when the pump or agitator is running.
- (xi) Outriggers.
- (A) Outriggers must be used in accordance with the manufacturer's specifications.
- (B) Concrete pump trucks manufactured after January 1, 1998, must have outriggers or jacks permanently marked to indicate the maximum loading they transmit to the ground.
- (xii) Load on a placing boom.
- (A) The manufacturer's or a licensed, registered, structural engineer's specifications for the placing boom must not be exceeded by:
- The weight of the load;
 - The length and diameter of suspended hose;
 - The diameter and weight of mounted pipe.
- (B) A concrete placing boom must not be used to drag hoses or lift other loads.
- (C) All engineering calculations regarding modifications must be:

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- Documented;
 - Recorded; and
 - Available upon request.
- (xiii) Pipe diameter thickness. The pipe wall thickness must be measured in accordance with the manufacturer's instruction, and:
- Be sufficient to maintain a burst pressure greater than the maximum pressure the pump can produce;
 - The pipe sections must be replaced when measurements indicate wall thickness has been reduced to the limits specified by the manufacturer.
- (xiv) Pipe clamps.
- (A) Concrete must not be pumped through a delivery system with grooved ends, such as those for Victualic-type couplers.
- (B) Pipe clamps must have a pressure rating at least equal to the pump pressure rating.
- (C) Pipe clamps contact surfaces must be free of concrete and other foreign matter.
- (D) If quick connect clamps are used, they must be pinned or secured to keep them from opening when used in a vertical application.
- (xv) Delivery pipe.
- (A) A delivery pipe between the concrete pump and the placing system must be supported and anchored to prevent movement and excessive loading on clamps.
- (B) Double ended hoses must not be used as whip hoses.
- (C) Attachments must not be placed on whip hoses (i.e., "S" hooks, valves, etc.).

Table 1. Nonmandatory recommended maximum yards per hour through hose

Hose Diameter	Hose Length (12' and less) Max. yards per hour	Hose Length (12' and longer) Max. yards per hour
2"	30	30
3"	90	50
4"	160	110
5"	See Manufacturer specs	See manufacturer specs

- The above figures are based on a minimum of a 4" slump and a 5 sack mix.
 - Variables in mix design can have an effect on these ratings.
 - Aggregate should not exceed 1/3 the diameter on these delivery system.
- (xvi) Restraining. A restraining device must:

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- Be used on attachments suspended from the boom tips; and
- Have a load rating not less than one-fifth of its ultimate breaking strength.

(xvii) Equipment inspection.

- (A) An inspection must be conducted annually for the first five years and semiannually thereafter and must include the following:
- Nondestructive testing of all sections of the boom by a method capable of ensuring the structural integrity of the boom;
 - Be conducted by a qualified person or by a private agency.
- (B) The inspection report must be documented and a copy maintained by the employer and in each unit inspected. It must contain the following:
- The identification, including the serial numbers and manufacturer's name, of the components and parts inspected and tested;
 - A description of the test methods and results;
 - The names and qualifications of the people performing the inspection;
 - A listing of necessary repairs; and
 - The signature of the manufacturer, an agent of the manufacturer, or a qualified person.

Note: See WAC 296-155-628(8)(d) for the inspection worksheet criteria.

(xviii) Equipment repair.

- (A) Replacement parts must meet or exceed the original manufacturer's specifications or be certified by a registered professional structural engineer.
- (B) A properly certified welder must perform any welding on the boom, outrigger, or structural component.

(xix) Compressed air cleaning of the piping system. To clean the piping system:

- (A) The pipe system must be securely anchored before it is cleaned out.
- (B) The flexible discharge hose must be removed.
- (C) Workers not essential to the cleaning process must leave the vicinity.
- (D) The compressed air system must have a shutoff valve.
- (E) Blow out caps must have a bleeder valve to relieve air pressure.
- (F) A trap basket or containment device (i.e., concrete truck, concrete bucket) must be available and secured to receive the clean out device.
- (G) Delivery pipes must be depressurized before clamps and fittings are released.

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- (c) Qualifications and training requirements.
- (i) Operator trainee-Qualification requirements. To be qualified to become a concrete pump operator, the trainee must meet the following requirements unless it can be shown that failure to meet the requirements will not affect the operation of the concrete pump boom.
- (A) Vision requirements:
- At least 20/30 Snellen in one eye and 20/50 in the other. Corrective lenses may be used to fulfill this requirement;
 - Ability to distinguish colors, regardless of position, if color differentiation is required;
 - Normal depth perception and field of vision.
- (B) Hearing requirements. Hearing adequate to meet operational demands. Corrective devices may be used to fulfill this requirement.
- (ii) Operator trainee-Training requirements. Operator trainee training requirements include, but are not limited to, the following:
- (A) Demonstrated their ability to read and comprehend the pump manufacturer's operation and safety manual.
- (B) Be of legal age to perform the duties required.
- (C) Received documented classroom training and testing (as applicable) on these recommended subjects:
- Driving, operating, cleaning and maintaining concrete pumps, placing booms, and related equipment;
 - Jib/boom extensions;
 - Boom length/angle;
 - Manufacturer's variances;
 - Radii;
 - Range diagram, stability, tipping axis; and
 - Structural/tipping determinations.
- (D) Maintain and have available upon request a copy of all training materials and a record of training.
- (E) Satisfactorily complete a written examination for the concrete pump boom for which they are becoming qualified. It will cover:
- Safety;
 - Operational characteristics and limitations; and
 - Controls.
- (iii) Operator-Qualifications requirements. Operators will be considered qualified when they have:

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- (A) Completed the operator trainee requirements listed in (c)(i) and (ii) of this subsection.
 - (B) Completed a program of training conducted by a qualified person, including practical experience under the direct supervision of a qualified person.
 - (C) Passed a practical operating examination of their ability to operate a specific model and type of equipment. Possess the knowledge and the ability to implement emergency procedures.
 - (D) Possess the knowledge regarding the restart procedure after emergency stop has been activated.
 - (E) Possess the proper class of driver's license to drive the concrete pump truck.
 - (F) Demonstrate the ability to comprehend and interpret all labels, safety decals, operator's manuals, and other information required to safely operate the concrete pump.
 - (G) Be familiar with the applicable safety requirements.
 - (H) Understand the responsibility for equipment maintenance.
- (d) Concrete pump inspection worksheet criteria. Concrete pump trucks will be inspected using the following criteria: The manufacturer's required inspection criteria will be followed in all instances.

Note: DOT requirements for inspections-Ref. 49 C.F.R. 396.11, Driver Vehicle Inspections and 396.13, Driver Pre-Trip Inspections; and WAC 296-155-610.

- (i) Hydraulic systems.
 - (A) Oil level;
 - (B) Hoses;
 - (C) Fittings;
 - (D) Holding valves;
 - (E) Pressure settings;
 - (F) Hydraulic cylinders;
 - (G) Ensure that the emergency stop system is functioning properly;
 - (H) All controls clearly marked.

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- (ii) Electrical.
 - (A) All systems functioning properly.
 - (B) All remote control functions are operating properly. Ensure that the emergency stop system is functioning properly.
 - (C) All controls clearly marked.
- (iii) Structural.
 - (A) Visual inspection for cracks, corrosion, and deformations of the concrete pump with placing boom structure, and all load carrying components such as outriggers, cross frames, torsion box beams, and delivery line support structures that may lead to nondestructive testing.
 - (B) Visual examination of all links, pivots, pins, and bolts.
 - (C) Vertical and horizontal movement at the turret, turntable, rotation gear lash, bearing tolerances, not to exceed manufacturer's specifications.
- (iv) Piping systems.
 - (A) Wall thickness must not exceed original manufacturer's specifications.
 - (B) Mounting hardware for attaching delivery system.
 - (C) Correct clamps and safety pins.
- (v) Safety decals.

All safety decals shall be in place as required by the manufacturer.
- (9) Concrete buckets.
 - (a) Concrete buckets equipped with hydraulic or pneumatic gates shall have positive safety latches or similar safety devices installed to prevent premature or accidental dumping.
 - (b) Concrete buckets shall be designed to prevent concrete from hanging up on top and the sides.
 - (c) Riding of concrete buckets for any purpose shall be prohibited, and vibrator crews shall be kept out from under concrete buckets suspended from cranes or cableways.
 - (d) When discharging on a slope, the wheels of ready-mix trucks shall be blocked and the brakes set to prevent movement.
- (10) Tremies. Sections of tremies and similar concrete conveyances shall be secured with wire rope (or equivalent materials in addition to the regular couplings or connections).

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- (11) Bull floats. Bull float handles, used where they might contact energized electrical conductors, shall be constructed of nonconductive material or insulated with a nonconductive sheath whose electrical and mechanical characteristics provide the equivalent protection of a handle constructed of nonconductive material.
- (12) Masonry saws shall be constructed, guarded, and operated in accordance with WAC 296-155-367 (1) through (4).
- (13) Lockout/tagout procedures. No employee shall be permitted to perform maintenance or repair activity on equipment (such as compressors, mixers, screens, or pumps used for concrete and masonry construction activities) where the inadvertent operation of the equipment could occur and cause injury, unless all potentially hazardous energy sources have been locked out and tagged in accordance with chapter 296-155 WAC, Part I.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 04-14-028 (Order 01-12), § 296-155-682, filed 06/29/04, effective 01/01/05. Statutory Authority: RCW 49.17.010, .040, .050. 00-21-102 (Order 99-09), § 296-155-682, filed 10/18/00, effective 02/01/01. Statutory Authority: Chapter 49.17 RCW. 95-10-016, § 296-155-682, filed 4/25/95, effective 10/1/95; 94-15-096 (Order 94-07), § 296-155-682, filed 7/20/94, effective 9/20/94; 91-03-044 (Order 90-18), § 296-155-682, filed 1/10/91, effective 2/12/91; 90-17-051 (Order 90-10), § 296-155-682, filed 8/13/90, effective 9/24/90; 89-11-035 (Order 89-03), § 296-155-682, filed 5/15/89, effective 6/30/89.]

WAC 296-155-683 Concrete finishing.

- (1) Scaffolds for use of cement finishers shall comply with the requirements of Scaffolds, chapter 296-874 WAC.
- (2) Where grinders, chippers, and other equipment is used which creates a thrust force while working on scaffolding, such scaffold shall be securely tied to a structure or held in with weighted drop lines.
- (3) Grinding and dressing operations carried on within closed rooms, stairwells, elevator shafts, etc., shall be provided with forced air ventilation.
- (4) Grinding machine operators shall wear respirators whenever machines are in operation or where dust hazard exists.
- (5) Eye protection shall be worn by workers engaged in grinding, chipping, or sacking concrete as required by WAC 296-155-215.

[Statutory Authority: Chapter 49.17.010, .040, .050, .060 RCW. 98-05-046 (Order 97-10), § 296-155-688, filed 2/13/98, effective 4/15/98. Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-155-683, filed 5/15/89, effective 6/30/89.]

WAC 296-155-684 Requirements for cast in place concrete.

- (1) General requirements for formwork.
 - (a) Formwork shall be designed, fabricated, erected, supported, braced, and maintained so that it will be capable of supporting without failure all vertical and lateral loads that may reasonably be anticipated to be applied to the formwork. Formwork which is designed, fabricated, erected, supported, braced, and maintained in conformance with the Appendix to this section will be deemed to meet the requirements of this subdivision.
 - (b) Any form, regardless of size, shall be planned in every particular and designed and constructed with an adequate factor of safety. In addition to computable loading, additional form pressures may result from impact during concrete placement, sudden lowering of temperatures retarding the set and increasing the liquid head or static pressure, vibrations of the form or concrete, uneven

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- stressing resulting from failure or weakening of form members, or impact from concrete buckets or placing equipment. As a result, an adequate factor of safety is required to offset these unpredictable conditions.
- (c) The thoroughness of planning and design shall be governed by the size, complexity, and intended use of the form. Formwork which is complex in nature or which will be subjected to unusually high concrete pressures shall be designed or approved for use by an engineer or experienced form designer.
- (2) Drawings or plans, including all revisions, for the jack layout, formwork (including shoring equipment), working decks, and scaffolds, shall be available at the jobsite.
- (3) Shoring and reshoring.
- (a) General: Shoring installations constructed in accordance with this standard shall be designed in accordance with American National Standard Recommended Practice for Concrete Formwork, ANSI-(ACI 347-78), Formwork for Concrete ACI 318-83, or with the following publications of the Scaffolding & Shoring Institute: Recommended Standard Safety Code for Vertical Shoring, 1970; Single Post Shore Safety Rules, 1969; and Steel Frame Shoring Safety, Safety Rules, 1969.
 - (b) All shoring equipment shall be inspected prior to erection to determine that it is as specified in the shoring layout.
 - (c) A shoring layout shall be prepared or approved by a person qualified to analyze the loadings and stresses which are induced during the construction process.
 - (d) A copy of the shoring layout shall be available at the jobsite.
 - (e) The shoring layout shall include all details of the specification, including unusual conditions such as heavy beams, sloping areas, ramps, and cantilevered slabs, as well as plan and elevation views.
 - (f) Shoring equipment found to be damaged such that its strength is reduced to less than that required by WAC 296-155-684 (1)(a) shall not be used for shoring.
 - (g) Erected shoring equipment shall be inspected immediately prior to, during, and immediately after concrete placement.
 - (h) Upon inspection, shoring equipment that is found to be damaged or weakened shall be immediately removed and replaced.
 - (i) The sills for shoring shall be sound, rigid, and capable of carrying the maximum intended load without settlement or displacement.
 - (j) All base plates, shore heads, extension devices, and adjustment screws shall be in firm contact, and secured when necessary, with the foundation and the form.
 - (k) Eccentric loads on shore heads and similar members shall be prohibited unless these members have been designed for such loading.

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- (l) The minimum total design load for any shoring used in slab and beam structures shall be not less than one hundred pounds per square foot for the combined live and dead load regardless of slab thickness; however, the minimum allowance for live load and formwork shall be not less than twenty pounds per square foot in addition to the weight of the concrete. Additional allowance for live load shall be added for special conditions other than when placing concrete for standard-type slabs and beams. Shoring shall also be designed to resist all foreseeable lateral loads such as wind, cable tensions, inclined supports, impact of placement, and starting and stopping of equipment. The assumed value of load due to wind, impact of concrete, and equipment acting in any direction at each floor line shall not be less than one hundred pounds per lineal foot of floor edge or two percent of total dead load of the floor, whichever is greater. (See subsection (3)(b) of this section.)
- (m) When motorized carts are used, the design load shall be increased twenty-five pounds per square foot.
- (4) The design stresses for form lumber and timbers shall be within the tolerance of the grade, condition, and species of lumber used.
- (5) The design stresses used for form lumber and timber shall be shown on all drawings, specifications, and shoring layouts.
- (6) All load-carrying timber members of scaffold framing shall be a minimum of 1500 f (stress grade) construction grade lumber. All dimensions are nominal sizes except that where rough sizes are noted, only rough or undressed lumber of the size specified shall satisfy minimum requirements.
- (7) When shoring from soil, an engineer or other qualified person shall determine that the soil is adequate to support the loads which are to be placed on it.
- (8) Precautions shall be taken so that weather conditions do not change the load-carrying conditions of the soil below the design minimum.
- (9) When shoring from fill or when excessive earth disturbance has occurred, an engineer or other qualified person shall supervise the compaction and reworking of the disturbed area and determine that it is capable of carrying the loads which are to be imposed upon it.
- (10) Suitable sills shall be used on a pan or grid dome floor or any other floor system involving voids where vertical shoring equipment could concentrate an excessive load on a thin concrete section.
- (11) When temporary storage of reinforcing rods, material, or equipment on top of formwork becomes necessary, these areas shall be sufficient to meet the loads.
- (12) If any deviation in the shoring plan is necessary because of field conditions, the person who prepared the shoring layout shall be consulted for approval of the actual field setup before concrete is placed.
- (13) The shoring setup shall be checked to insure that all details of the layout have been met.
- (14) The completed shoring setup shall be a homogenous unit or units and shall have the specified bracing to give it lateral stability.
- (15) The shoring setup shall be checked to make certain that bracing specified in the shoring layout for lateral stability is in place.

WAC 296-155-684 (Cont.)

- (16) All vertical shoring equipment shall be plumb. Maximum allowable deviation from the vertical is one-eighth inch in three feet. If this tolerance is exceeded, the shoring equipment shall not be used until readjusted within this limit.
- (17) Upon inspection, shoring equipment that is found to be damaged or weakened shall be immediately removed and replaced.
- (18) Shoring equipment shall not be released or removed until the approval of a qualified engineer has been received.
- (19) Removal of shoring equipment shall be planned so that the equipment which is still in place is not overloaded.
- (20) Slabs or beams which are to be reshored should be allowed to take their actual permanent deflection before final adjustment of reshoring equipment is made.
- (21) While the reshoring is underway, no construction loads shall be permitted on the partially-cured concrete.
- (22) The allowable load on the supporting slab shall not be exceeded when reshoring.
- (23) The reshoring shall be thoroughly checked to determine that it is properly placed and that it has the load capacity to support the areas that are being reshored.

[Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), § 296-155-684, filed 7/20/94, effective 9/20/94; 89-11-035 (Order 89-03), § 296-155-684, filed 5/15/89, effective 6/30/89.]

WAC 296-155-685 Tubular welded frame shoring.

- (1) Metal tubular frames used for shoring shall have allowable loads based on tests conducted according to the Recommended Procedure for Compression Testing of Scaffolds and Shores, Scaffolding & Shoring Institute, 1967.
- (2) Design of shoring layouts shall be based on allowable loads which were obtained using the test procedures of subsection (1) of this section and on at least a two and one-half to one safety factor.
- (3) All metal frame shoring equipment shall be inspected before erection.
- (4) Metal frame shoring equipment and accessories shall not be used if heavily rusted, bent, dented, rewelded, or having broken weldments or other defects.
- (5) All locking devices on frames and braces shall be in good working order, coupling pins shall align the frame or panel legs, pivoted cross braces shall have their center pivot in place, and all components shall be in a condition similar to that of original manufacture.
- (6) When checking the erected shoring frames with the shoring layout, the spacing between towers and cross-brace spacing shall not exceed that shown on the layout, and all locking devices shall be in the closed position.
- (7) Devices for attaching the external lateral stability bracing shall be securely fastened to the legs of the shoring frames.
- (8) All baseplates, shore heads, extension devices, or adjustment screws shall be in firm contact with the footing sill and the form material, and shall be snug against the legs of the frames.

WAC 296-155-685 (Cont.)

- (9) Eccentric loads on shore heads and similar members shall be prohibited unless the shore heads have been designed for such loading.
- (10) When formwork is installed at an angle, or sloping, or when the surface shored from is sloping, the shoring shall be designed for such loading.
- (11) Adjustment screws shall not be adjusted to raise formwork after the concrete is in place.
[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-155-685, filed 5/15/89, effective 6/30/89; Order 74-26, § 296-155-685, filed 5/7/74, effective 6/6/74.]

WAC 296-155-686 Tube and coupler shoring.

- (1) Tube and coupler towers used for shoring shall have allowable loads based on tests conducted according to the Recommended Procedure for Compression Testing of Scaffolds and Shores, Scaffolding & Shoring Institute, 1967.
- (2) Design of shoring layouts shall be based on working loads which were obtained using the test procedures of subsection (1) of this section and on at least a two and one-half to one safety factor.
- (3) All tube and coupler components shall be inspected before being used.
- (4) Tubes of shoring structures shall not be used if heavily rusted, bent, dented, or having other defects.
- (5) Couplers (clamps) shall not be used if deformed, broken, or having defective or missing threads on bolts, or other defects.
- (6) The material used for the couplers (clamps) shall be of a structural type such as drop-forged steel, malleable iron, or structural grade aluminum. Gray cast iron shall not be used.
- (7) When checking the erected shoring towers with the shoring layout, the spacing between posts shall not exceed that shown on the layout, and all interlocking of tubular members and tightness of couplers should be checked.
- (8) All baseplates, shore heads, extension devices, or adjustment screws shall be in firm contact with the footing sill and the form material, and shall be snug against the posts.
- (9) Eccentric loads on shore heads and similar members shall be prohibited unless the shore heads have been designed for such loading.
- (10) Special precautions shall be taken when formwork is at angles, or sloping, or when the surface shored from is sloping.
- (11) Adjustment screws shall not be adjusted to raise formwork after the concrete is in place.
[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-155-686, filed 5/15/89, effective 6/30/89.]

WAC 296-155-687 Single post shores.

- (1) When checking erected single post shores with the shoring layout, the spacing between shores in either direction shall not exceed that shown on the layout, and all clamps, screws, pins, and all other components shall be in the closed or engaged position.

WAC 296-155-687 (Cont.)

- (2) For stability, single post shores shall be horizontally braced in both the longitudinal and transverse directions. Diagonal bracing shall also be installed. Such bracing shall be installed as the shores are being erected.
- (3) Devices which attach to the external lateral stability bracing shall be securely fastened to the single post shores.
- (4) All baseplates or shore heads of single post shores shall be in firm contact with the footing sill and the form material.
- (5) Whenever single post shores are used in more than one tier, the layout shall be designed and inspected by a structural engineer.
- (6) Eccentric loads on shore heads shall be prohibited unless the shore heads have been designed for such loading.
- (7) When formwork is at an angle, or sloping, or when the surface shored from is sloping, the shoring shall be designed for such loading.
- (8) Adjustment of single post shores to raise formwork shall not be made after concrete is in place.
- (9) Respecting fabricated single post shores, the following shall apply:
 - (a) The clamp used for adjustable timber single post shores shall have working load ratings based on tests conducted according to the standard test procedures for fabricated single post shores in Recommended Procedure for Compression Testing of Scaffolds and Shores, Scaffolding & Shoring Institute, 1967, and on at least a three to one safety factor.
 - (b) Shoring layouts shall be made using working loads which were obtained using the test procedures of (a) of this subsection, and on at least a three to one safety factor.
 - (c) All fabricated single post shores shall be inspected before being used.
 - (d) Fabricated single post shores shall not be used if heavily rusted, bent, dented, rewelded, or having broken weldments or other defects. If they contain timber, they shall not be used if timber is split, cut, has sections removed, is rotted, or otherwise structurally damaged.
 - (e) All clamps, screws, pins, threads, and all other components shall be in a condition similar to that of original manufacture.
- (10) Respecting adjustable timber single post shores, the following shall apply:
 - (a) The clamp used for adjustable timber single post shores shall have working load ratings based on tests conducted according to the standard test procedures for fabricated single post shores in Recommended Procedure for Compression Testing of Scaffolds and Shores, Scaffolding & Shoring Institute, 1967, and on at least a three to one safety factor.
 - (b) Timber used shall have the safety factor and allowable working load for each grade and species as recommended in the Tables for wooden columns in the Wood Structural Design Data Book, National Forest Products Association, 1970.

WAC 296-155-687 (Cont.)

- (c) The shoring layout shall be made using the allowable load obtained by using the test procedure for the clamp or Tables for timber referred to in (a) and (b) of this subsection.
 - (d) All timber and adjusting devices to be used for adjustable timber single post shores shall be inspected before erection.
 - (e) Timber shall not be used if it is split, cut, has sections removed, is rotted, or is otherwise structurally damaged.
 - (f) Adjusting devices shall not be used if heavily rusted, bent, dented, rewelded, or having broken weldments or other defects.
 - (g) All nails used to secure bracing on adjustable timber single post shores shall be driven home and the point of the nail bent over.
- (11) Respecting timber single post shores, the following shall apply:
- (a) Timber used as single post shores shall have the safety factor and allowable working load for each grade and species as recommended in the Tables for wooden columns in the Wood Structural Design Data Book, National Forest Products Association, 1970.
 - (b) The shoring layout shall be prepared by using working loads obtained by using the Tables referred to in (a) of this subsection.
 - (c) All timber to be used for single post shoring shall be inspected before erection.
 - (d) Timber shall not be used if it is split, cut, has sections removed, is rotted, or is otherwise structurally damaged.
 - (e) All nails used to secure bracing on timber single post shores shall be driven home and the point of the nail bent over.
- (12) Tiered single post shores. Whenever single post shores are used one on top of another (tiered), the employer shall comply with the following specific requirements in addition to the general requirements for formwork:
- (a) The design of the shoring shall be prepared by a qualified designer and the erected shoring shall be inspected by an engineer qualified in structural design.
 - (b) The single post shores shall be vertically aligned.
 - (c) The single post shores shall be spliced to prevent misalignment.
 - (d) The single post shores shall be adequately braced in two mutually perpendicular directions at the splice level. Each tier shall also be diagonally braced in the same two directions.
 - (e) Adjustment of single post shores to raise formwork shall not be made after the placement of concrete.
 - (f) Reshoring shall be erected, as the original forms and shores are removed, whenever the concrete is required to support loads in excess of its capacity.

[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-155-687, filed 5/15/89, effective 6/30/89.]

WAC 296-155-688 Vertical slip forms.

- (1) Slip forms shall be designed and constructed, and the form movement carried out, under the immediate supervision of a person or persons experienced in slip form design and operation. Drawings prepared by a qualified engineer, showing the jack layout, formwork, working decks, and scaffolding, shall be available at the jobsite, and followed.
- (2) The steel rods or pipe on which the jacks climb or by which the forms are lifted shall be designed for this purpose. Such rods must be adequately braced where not encased in concrete.
- (3) Forms shall be designed to prevent excessive distortion of the structure during the jacking operation.
- (4) All vertical slip forms shall be provided with scaffolding or work platforms completely encircling the area of placement.
- (5) Jacks and vertical supports shall be positioned in such a manner that the loads do not exceed the rated capacity of the jacks.
- (6) The jacks or other lifting devices shall be provided with mechanical dogs or other automatic holding devices to support the slip forms whenever failure of the power supply or lifting mechanism occurs.
- (7) The form structure shall be maintained within all design tolerances specified for plumbness during the jacking operation.
- (8) Lifting shall proceed steadily and uniformly and shall not exceed the predetermined safe rate of lift. A jacking system, which provides precise, simultaneous movement of the entire form in small preselected increments, is recommended for large structures.
- (9) Workers placing reinforcing steel shall comply with the requirements of chapter 296-155 WAC, Part C-1 when working above the scaffold level.
- (10) The total allowable load on slip form platforms shall be determined by the design engineer and enforced by the field supervisor.
- (11) Lateral and diagonal bracing of the forms shall be provided to prevent excessive distortion of the structure during the sliding operation.
- (12) While the slide is in operation, the form structure shall be maintained in line and plumb.
- (13) A field supervisor experienced in slip form construction shall be present on the deck at all times.

[Statutory Authority: Chapter 49.17.010, .040, .050, .060 RCW. 98-05-046 (Order 97-10), § 296-155-688, filed 2/13/98, effective 4/15/98. Chapter 49.17 RCW. 91-03-044 (Order 90-18), § 296-155-688, filed 1/10/91, effective 2/12/91; 89-11-035 (Order 89-03), § 296-155-688, filed 5/15/89, effective 6/30/89.]

WAC 296-155-689 Placing and removal of forms.

- (1) When moved or raised by crane, cableway, A-frame, or similar mechanical device, forms shall be securely attached to slings having a minimum safety factor of five. Use of No. 9 tie wire, fiber rope, and similar makeshift lashing shall be prohibited.
- (2) Taglines shall be used in moving panels or other large sections of forms by crane or hoist.

WAC 296-155-689 (Cont.)

- (3) All hoisting equipment, including hoisting cable used to raise and move forms shall have a minimum safety factor incorporated in the manufacturer's design, and the manufacturer's recommended loading shall not be exceeded. Field-fabricated or shop-fabricated hoisting equipment shall be designed or approved by a registered professional engineer, incorporating a minimum safety factor of five in its design. Panels and built-up form sections shall be equipped with metal hoisting brackets for attachment of slings.
- (4) Forms intended for use where there is a free fall of over ten feet shall be equipped with adequate scaffolding and guardrails, or employees working on the forms shall be protected from falls in accordance with chapter 296-155 WAC, Part C-1 during forming and stripping operations.
- (5) Vertical forms being raised or removed in sections shall not be released until adequately braced or secured. Overhead forms shall not be released until adequately braced or secured.
- (6) Workers or others at lower levels shall be protected from falling materials. Appropriate warning signs shall be erected along walkways.
- (7) Forms shall not be removed until the concrete is cured. The concrete shall be adequately set in order to permit safe removal of the forms, shoring, and bracing. Engineer's specifications and local building codes shall be adhered to in determining the length of time forms should remain in place following concrete placement. In addition, tests shall be made on field-cured concrete specimens in order to insure that concrete has obtained sufficient strength to safely support the load prior to removal of forms.

[Statutory Authority: Chapter 49.17.010, .040, .050, .060 RCW. 98-05-046 (Order 97-10), § 296-155-689, filed 2/13/98, effective 4/15/98. Chapter 49.17 RCW. 91-03-044 (Order 90-18), § 296-155-689, filed 1/10/91, effective 2/12/91; 89-11-035 (Order 89-03), § 296-155-689, filed 5/15/89, effective 6/30/89.]

WAC 296-155-690 Appendix to WAC 296-155-684 cast in place concrete. General requirements for formwork.

(This Appendix is nonmandatory.)

This Appendix serves as a nonmandatory guideline to assist employers in complying with the formwork requirements in WAC 296-155-684 (1)(a). Formwork which has been designed, fabricated, erected, braced, supported, and maintained in accordance with Sections 6 and 7 of the American National Standard for Construction and Demolition Operations-Concrete and Masonry Work, ANSI A10.9-1983, shall be deemed to be in compliance with the provision of WAC 296-155-684 (1)(a).

[Statutory Authority: Chapter 49.17 RCW. 90-03-029 (Order 89-20), § 296-155-690, filed 1/11/90, effective 2/26/90; 89-11-035 (Order 89-03), § 296-155-690, filed 5/15/89, effective 6/30/89. Statutory Authority: RCW 49.17.040 and 49.17.050. 86-03-074 (Order 86-14), § 296-155-690, filed 1/21/86; Order 74-26, § 296-155-690, filed 5/7/74, effective 6/6/74.]

WAC 296-155-691 Precast concrete and tilt-up operations.

- (1) It shall be the responsibility of the contractor to use accessories which are designed to be compatible.
- (2) The design capacity of all lifting devices and accessories shall be known. The devices and accessories with the appropriate capacity shall be used.
- (3) Prior to pouring the panels of a tilt-up type construction job, a set of plans or job specifications, including lifting procedures, shall be drawn up.
 - (a) These plans shall be at the job site and made available upon request.
 - (b) Any changes made in the rigging procedure of a tilt-up panel or slab shall provide the same degree of safety as required by the original plans.

WAC 296-155-691 (Cont.)

- (c) The plans or specifications shall contain the following information:
 - (i) The type, size, and location of all lifting inserts.
 - (ii) The type, size, and location of all brace inserts or fittings for guy wires in each panel and floor or support.
 - (iii) The size of braces or guys to be used.
 - (iv) The compression strength which concrete panels must attain prior to being lifted.
- (4) The following conditions shall be included in the erection process and shall be incorporated in the design plan:
 - (a) Braces and all associated components of the bracing system shall be designed to incorporate a safety factor of one and one-half to resist any normal stresses to which they may be subjected, including normal high wind velocity pressures for the area.
 - (b) Precast concrete wall units, structural framing, and tilt-up wall panels shall be adequately supported to prevent overturning and to prevent collapse until permanent connections are completed.
 - (c) Floor braces used to secure panel sections shall be placed at an angle of not less than forty-five degrees or more than sixty degrees from horizontal when physically possible to install in this manner.
 - (d) The bracing on all panel sections shall be installed in such a manner as to prevent the panel from accidentally rotating.
 - (e) Each panel section not secured by other means shall have a minimum of two braces. The braces shall be installed in such a manner as to evenly distribute the load or guy wires, when properly installed, may be used in lieu of stiff leg braces.
 - (f) If braces are attached to a panel or slab by bolts tightened into inserts installed in holes drilled in concrete, the type of inserts used and method of installation shall be such as to develop the required strength to be maintained for the bracing system.
 - (g) Inserts to be installed for lifting sections of tilt-up precast panels shall be designed mechanically to maintain a safety factor of three.
 - (h) Lifting inserts which are embedded or otherwise attached to precast concrete members, other than the tilt-up members, shall be capable of supporting at least four times the maximum intended load applied or transmitted to them.
 - (i) The compression strength of the concrete shall be such that when the proper type, size, and amount of inserts are installed a minimum safety factor of two will be maintained.
 - (j) Lifting hardware shall be capable of supporting at least five times the maximum intended load applied or transmitted to the lifting hardware.

WAC 296-155-691 (Cont.)

- (k) Lifting bolts or other lifting devices which have been bent, worn, or are defective shall be discarded.
 - (l) The upper and lower sections of telescoping type braces shall be secured by high tensile steel pins or bolts which provide adequate shear strength and which will positively secure against accidental removal.
 - (m) Manufactured products shall not be altered in a manner which would reduce the safe working load to less than its original value.
 - (n) Inserts shall be positioned so that bolts, or lifting devices, when inserted, will be perpendicular to the face on which they are placed.
- (5) Design of the panels and layout of the pour shall be made in such a manner so that when picking, the top of the panel will be away from the crane. If this is not possible, the contractor shall consult with a representative of the department and the crane company involved to determine the procedure to be followed in lifting and placing in its permanent position safely. Panels shall be lifted and handled in such a manner that they will not strike the hoisting equipment, in case of failure.
- (a) Physical stops shall be provided which will prevent the bottom edge of a panel being set from slipping off the edge of its supporting structure.
 - (b) Tilt-up panels shall not be set when there is a possibility that wind velocity would create a hazardous condition.
 - (c) A qualified signalperson shall be designated and shall consult with the crane operator on lifting procedures prior to making the pick. The signalperson shall be located in such a position during the pick of the panel that they can observe both the crane operator and the employees working in the immediate area.
 - (d) During the lifting process, workers shall keep clear of the under side of the panel.
 - (e) Persons not involved in the lifting process shall be kept clear of the hazardous area near where panels are being raised, moved or placed.
 - (f) If braces must be removed temporarily during construction, other effective means shall be provided to safely support the panel during the interim period.
 - (g) Each panel shall be properly braced or otherwise secured prior to removal of the hoisting equipment.
 - (h) Short panels or sections not otherwise supported by floor, footings, columns or other structure, shall be properly shored.

[Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), § 296-155-691, filed 7/20/94, effective 9/20/94; 90-17-051 (Order 90-10), § 296-155-691, filed 8/13/90, effective 9/24/90; 89-11-035 (Order 89-03), § 296-155-691, filed 5/15/89, effective 6/30/89.]

WAC 296-155-694 Requirements for lift-slab construction operations.

- (1) Lift-slab operations shall be designed and planned by a registered professional engineer who has experience in lift-slab construction. Such plans and designs shall be implemented by the employer and shall include detailed instructions and sketches indicating the prescribed method of erection. These plans and designs shall also include provisions for ensuring lateral stability of the building/structure during construction.
- (2) Jacks/lifting units shall be marked to indicate their rated capacity as established by the manufacturer.
- (3) Jacks/lifting units shall not be loaded beyond their rated capacity as established by the manufacturer.
- (4) Jacking equipment shall be capable of supporting at least two and one-half times the load being lifted during jacking operations and the equipment shall not be overloaded. For the purpose of this provision, jacking equipment includes any load bearing component which is used to carry out the lifting operation(s). Such equipment includes, but is not limited to, the following: Threaded rods, lifting attachments, lifting nuts, hook-up collars, T-caps, shearheads, columns, and footings.
- (5) Jacks/lifting units shall be designed and installed so that they will neither lift nor continue to lift when they are loaded in excess of their rated capacity.
- (6) Jacks/lifting units shall have a safety device installed which will cause the jacks/lifting units to support the load in any position in the event any jack/lifting unit malfunctions or losses [loses] its lifting ability.
- (7) Jacking operations shall be synchronized in such a manner to ensure even and uniform lifting of the slab. During lifting, all points at which the slab is supported shall be kept within 1/2 inch of that needed to maintain the slab in a level position.
- (8) If leveling is automatically controlled, a device shall be installed that will stop the operation when the 1/2 inch tolerance set forth in subsection (7) of this section is exceeded or where there is a malfunction in the jacking (lifting) system.
- (9) If leveling is maintained by manual controls, such controls shall be located in a central location and attended by a competent person while lifting is in progress. In addition to meeting the definition in WAC 296-155-012(4), the competent person must be experienced in the lifting operation and with the lifting equipment being used.
- (10) The maximum number of manually controlled jacks/lifting units on one slab shall be limited to a number that will permit the operator to maintain the slab level within specified tolerances of subsection (7) of this section, but in no case shall that number exceed 14.
- (11) No employee, except those essential to the jacking operation, shall be permitted in the building/structure while any jacking operation is taking place unless the building/structure has been reinforced sufficiently to ensure its integrity during erection. The phrase **“reinforced sufficiently to ensure its integrity”** used in this subsection means that a registered professional engineer, independent of the engineer who designed and planned the lifting operation, has determined from the plans that if there is a loss of support at any jack location, that loss will be confined to that location and the structure as a whole will remain stable.
 - (a) Under no circumstances, shall any employee who is not essential to the jacking operation be permitted immediately beneath a slab while it is being lifted.
 - (b) For the purpose of subsection (11) of this section, a jacking operation begins when a slab or group of slabs is lifted and ends when such slabs are secured (with either temporary connections or permanent connections).

WAC 296-155-694 (Cont.)

- (c) Employers who comply with Appendix A to WAC 296-155-694 shall be considered to be in compliance with the provisions of subsections (11) through (11)(c) of this section.
- (12) When making temporary connections to support slabs, wedges shall be secured by tack welding, or an equivalent method of securing the wedges to prevent them from falling out of position. Lifting rods may not be released until the wedges at that column have been secured.
- (13) All welding on temporary and permanent connections shall be performed by a certified welder, familiar with the welding requirements specified in the plans and specifications for the lift-slab operation.
- (14) Load transfer from jack/lifting units to building columns shall not be executed until the welds on the column shear plates (weld blocks) are cooled to air temperature.
- (15) Jacks/lifting units shall be positively secured to building columns so that they do not become dislodged or dislocated.
- (16) Equipment shall be designed and installed so that the lifting rods cannot slip out of position or the employer shall institute other measures, such as the use of locking or blocking devices, which will provide positive connection between the lifting rods and attachments and will prevent components from disengaging during lifting operations.

Appendix to WAC 296-155-694-Lift-slab operations

(This appendix is nonmandatory.)

In WAC 296-155-694(11), WISHA requires employees to be removed from the building/structure during jacking operations unless an independent registered professional engineer, other than the engineer who designed and planned the lifting operation, has determined that the building/structure has been sufficiently reinforced to insure the integrity of the building/structure. One method to comply with this provision is for the employer to ensure that continuous bottom steel is provided in every slab and in both directions through every wall or column head area. (**Column head area** means the distance between lines that are one and one half times the thickness of the slab or drop panel. These lines are located outside opposite faces of the outer edges of the shearhead sections-See Figure 1.) The amount of bottom steel shall be established by assuming loss of support at a given lifting jack and then determining the steel necessary to carry, by catenary action over the span between surrounding supports, the slab service dead load plus any service dead and live loads likely to be acting on the slab during jacking. In addition, the surrounding supports must be capable of resisting any additional load transferred to them as a result of the loss of support at the lifting jack considered.

WAC 296-155-694 (Cont.)

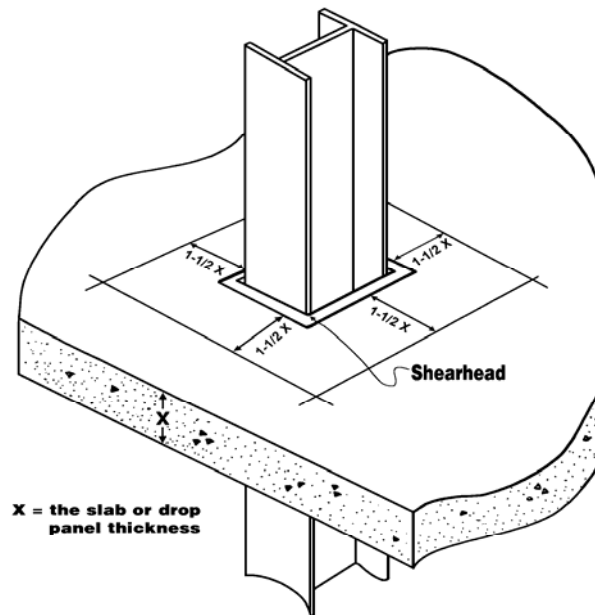


Figure 1 -- Column Head Area

[Statutory Authority: Chapter 49.17 RCW and RCW 49.17.040, [49.17].050 and [49.17].060. 92-22-067 (Order 92-06), § 296-155-694, filed 10/30/92, effective 12/8/92. Statutory Authority: Chapter 49.17 RCW. 91-11-070 (Order 91-01), § 296-155-694, filed 5/20/91, effective 6/20/91; 90-03-029 (Order 89-20), § 296-155-694, filed 1/11/90, effective 2/26/90; 89-11-035 (Order 89-03), § 296-155-694, filed 5/15/89, effective 6/30/89.]

WAC 296-155-695 Miscellaneous concrete construction.

- (1) General provisions.
 - (a) Deadheads used in post tensioning of tendons shall be the type that will increase the grip on the cable as the tension is increased.
 - (b) Proper means and equipment shall be used to prevent the over-tensioning of the tendons.
 - (c) Only qualified workers shall perform this type work.
- (2) Prestressed and poststressed concrete operations.
 - (a) Anchor fitting. In utilizing anchor fittings for tensioned strands, the recommendations and instructions of the supplier concerning installation, maintenance, and replacement shall be followed.
 - (b) Tools and strand vices shall be kept clean and in good repair.
 - (c) Safety factor.
 - (i) Expendable strand deflection devices used to pretension concrete members shall have a minimum safety factor of two.

WAC 296-155-695 (Cont.)

- (ii) Reusable strand deflection devices shall have a minimum safety factor of three.
- (d) Jacking operations.
 - (i) During jacking operations of any tensioning element or group of tensioning elements, the anchors shall be kept turned up close to the anchorplate.
 - (ii) No one shall be permitted to stand in line or directly over the jacking equipment during tensioning operations.
 - (iii) Employees shall not stand behind the jack during tensioning operations.
- (e) Jacking and pulling equipment. Pulling headers, bolts, and hydraulic rams shall be frequently inspected for indication of fatigue, and the threads on bolts and nuts inspected for diminishing cross section.
- (f) Storage. Stressed members shall be stored on a level base and adequately supported during storage and transportation to prevent tipping.
- (g) Rigging.
 - (i) Stressed members shall be handled at pick points specifically designated on the manufacturer's drawings.
 - (ii) Stressed members shall be lifted with lifting devices recommended by the manufacturer or the engineer in charge.
 - (iii) No one shall be allowed under stressed members during lifting and erection.

[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-155-695, filed 5/15/89, effective 6/30/89. Statutory Authority: RCW 49.17.040 and 49.17.050. 86-03-074 (Order 86-14), § 296-155-695, filed 1/21/86; Order 74-26, § 296-155-695, filed 5/7/74, effective 6/6/74.]

WAC 296-155-697 Requirements for masonry construction.

- (1) A limited access zone shall be established whenever a masonry wall is being constructed. The limited access zone shall conform to the following:
- (2) The limited access zone shall be established prior to the start of construction of the wall.
- (3) The limited access zone shall be equal to the height of the wall to be constructed plus four feet, and shall run the entire length of the wall.
- (4) The limited access zone shall be established on the side of the wall which will be unscaffolded.
- (5) The limited access zone shall be restricted to entry by employees actively engaged in constructing the wall. No other employees shall be permitted to enter the zone.
- (6) The limited access zone shall remain in place until the wall is adequately supported to prevent overturning and to prevent collapse unless the height of wall is over eight feet, in which case, the limited access zone shall remain in place until the requirements of subsection (7) of this section have been met.

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- (7) All masonry walls over eight feet in height shall be adequately braced to prevent overturning and to prevent collapse unless the wall is adequately supported so that it will not overturn or collapse. The bracing shall remain in place until permanent supporting elements of the structure are in place.
- (8) Employees engaged in cutting or chipping shall wear suitable eye protection in accordance with WAC 296-155-215.
- (9) Masonry saws shall be constructed, guarded and operated in accordance with WAC 296-155-367 (1) through (4).
- (10) Persons charged with operation of derricks used for stone setting shall be qualified in that type of work.
- (11) Stone shall be set directly on the wall by the derrick.
- (12) Breast derricks when used in setting stone shall be secured against a slip or kick back and guyed with wire cables. Provide hold down line to prevent derrick from falling back.
- (13) Stone cutters shall wear goggles while trimming stone or cutting holes.
- (14) Pins shall be tested for security before stone is hoisted.
- (15) Hoisting cables shall be protected from chafing and wearing over corners.
- (16) Mason's mortar mixers shall have a bar-type grill installed over the mixer opening. The guard shall be installed with an automatic disconnect switch to stop the mixer tub rotation and prevent the mixer from starting whenever the guard is not in place.

[Statutory Authority: Chapter 49.17 RCW. 90-17-051 (Order 90-10), § 296-155-697, filed 8/13/90, effective 9/24/90; 90-03-029 (Order 89-20), § 296-155-697, filed 1/11/90, effective 2/26/90; 89-11-035 (Order 89-03), § 296-155-697, filed 5/15/89, effective 6/30/89.]

WAC 296-155-699 Appendix A to Part O-References to Part O of chapter 296-155 WAC. (This Appendix is nonmandatory.)

The following nonmandatory references provide information which can be helpful in understanding and complying with the requirements contained in Part O.

- Accident Prevention Manual for Industrial Operations; Eighth Edition; National Safety Council.
- Building Code Requirements for Reinforced Concrete (ACI 318-83).
- Formwork for Concrete (ACI SP-4).
- Recommended Practice for Concrete Formwork (ACI 347-78).
- Safety Requirements for Concrete and Masonry Work (ANSI A10.9-1983).
- Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens (ASTM C39-86).

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- Standard Test Method for Making and Curing Concrete Test Specimens in the Field
(ASTM C31-85).
- Standard Test Method for Penetration Resistance of Hardened Concrete (ASTM C803-82).
- Standard Test Method for Compressive Strength of Concrete Cylinders Cast In-Place in Cylindrical Molds (ASTM C873-85).
- Standard Method for Developing Early Age Compressive Test Values and Projecting Later Age Strengths (ASTM C918-80).
- Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as Used in Construction (ASTM E329-77).
- Method of Making and Curing Concrete Test Specimens in the Laboratory (ASTM C192-88).
- Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
(ASTM C42-87).
- Methods of Securing, Preparing and Testing Specimens from Hardened Lightweight Insulating Concrete for Compressive Strength (ASTM C513-86).
- Test Method for Comprehensive Strength of Lightweight Insulating Concrete
(ASTM C495-86).
- Method of Making, Accelerating Curing, and Testing of Concrete Compression Test Specimens (ASTM C684-81).
- Test Method for Compressive Strength of Concrete Using Portions of Beams Broken in Flexure (ASTM C116-68 (1980)).

[Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), § 296-155-699, filed 7/20/94, effective 9/20/94; 89-11-035 (Order 89-03), § 296-155-699, filed 5/15/89, effective 6/30/89.]